IN THE DRAWINGS:

In order to comply with the regulations of 37 C.F.R. § 1.84, Applicants submit herewith substitute drawing sheets.

Kindly replace the drawing sheets (12 pages, Figures 1-12) currently on file with the drawing sheets attached hereto.

REMARKS

The specification and claims of this application have not been changed. Only modifications to the format have been affected to comply with the requirements of the Notice to File Corrected Application Papers mailed on October 18, 2001. Accordingly, these modification do not constitute new matter and are not intended to change the scope of the claims.

Respectfully submitted,

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Substitute Pages

surface-to -air missiles, torpedoes or other types of interceptors is equally envisioned.

[00101] It is understood that the above described embodiments are merely illustrative of the possible specific embodiments which may represent application of principles of the present invention. Other arrangements may readily be devised in accordance with these principles by those skilled in the art without departing from the scope and spirit of the invention.

What is Claimed is:

Sub A1

1. A system for guiding a device toward an object comprising:

means for generating a guidance command signal from: a vectored line-of-sight (LOS) between a device and an object using a position parameter of the object relative to a guidance frame, and an estimated object state produced in the guidance frame using the vectored line-of-sight; and

means for transmitting the guidance command signal to an on-board guidance control of the device.

2. A system for guiding a device toward an object in accordance with claim 1, wherein the means for generating a guidance command signal creates an estimated object to device range vector, an estimated object to device velocity vector and an estimated object acceleration vector.

3. A system for guiding a device toward an object in accordance with claim 2, wherein the means for generating a guidance command signal creates an estimated object acceleration rate vector.

4. A system for guiding a device toward an object in accordance with claim 1, wherein the means for generating a guidance command signal is periodically adaptive.

5. A system for guiding a device toward an object in accordance with claim 1, wherein the means for generating a guidance command signal comprises:

means for generating a set of probability weights.

6. A system for guiding a device toward an object in accordance with claim 5, wherein the sum of the probability weights for any axis of the guidance frame is unity.

7. A system for guiding a device toward an object in accordance with claim 1, wherein the means for generating a guidance command signal uses sequential line-of-sight (LOS) vectors in the guidance frame.

8. A system for guiding a device toward an object in accordance with claim 1, wherein the means for generating a guidance command signal comprises:

at least one Kalman filter bank.

9. A system for guiding a device toward an object in accordance with claim 8, wherein the at least one Kalman filter bank is harmonically balanced.

10. A system for guiding a device toward an object in accordance with claim 9, wherein each of the at least one Kalman filter bank is associated with a respective axis in the guidance frame.

11. A system for guiding a device toward an object in accordance with claim 1, wherein the means for generating a guidance command signal comprises:

a proportional navigation controller.

Sub A2

12. A system for guiding a device toward an object in accordance with claim 1, wherein the means for generating a guidance command signal comprises;

an augmented proportional navigational controller.

13. A system for guiding a device toward an object in accordance with claim 1, wherein the means for generating a guidance command signal comprises:

a classical optimal controller.

Sub A3

14. A method for guiding a device toward an object comprising the steps of:

creating a vectored object line-of-sight (LOS)in a guidance frame;

producing an estimated object state, using sequential object LOS;

using proportional navigation control to create a device guidance command as a function of an estimated range vector and an estimated velocity vector obtained using the estimated object state.

15. A method for guiding a device toward an object in accordance with claim 14, wherein the estimated object state is adaptively produced.

16. A method for guiding a device toward an object in accordance with claim 15, comprising the steps of:

creating a periodically adaptive guidance command using estimated object state; and,

adding the periodically adaptive guidance command to the device guidance command.

17. A method for guiding a device toward an object according to claim 15, wherein the step of creating a device guidance command comprises the step of:

creating a guidance command operating on device acceleration to compensate for autopilot lag.

Sub A4

18. A method for guiding a device toward an object according to claim 16, wherein the step of creating an periodically adaptive guidance command comprises the step of;

using a function of object maneuver frequencies, time-to-go before intercept, maneuver frequency correlation time constants, estimated target accelerations and estimated object acceleration rates.

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20. A method for guiding a device toward an object in accordance with claim 14, wherein the step of creating a vectored object line-of-sight comprises the steps of:

a) obtaining azimuth, elevation and range information of an object;

b) using the azimuth, elevation and range information for vectored LOS reconstruction to create a unit vector representative of the object's orientation in a guidance frame of the device; and,

c) applying the range information to the output of the vectored LOS reconstruction to create the estimated range.

Sub A5

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21. A method for guiding a device toward an object in accordance with claim 20, wherein the step of producing an estimated object state comprises the step of:

processing plural sequential estimated range vectors into an object state estimator in an inertial guidance frame estimated object state, wherein the estimated object state can include range, velocity, object acceleration and object acceleration rate.

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~~22~~. A guidance system for guiding a device toward an object comprising:

means for generating a signal representing a predicted position of the object from: object position parameters relative to a guidance frame and a periodically adaptive estimated object state produced in the guidance frame using the object position parameters; and,

means for transmitting the signal to an on-board guidance control of the device.

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~~23~~. A guidance system for guiding a device toward an object according to claim 22, comprising;

a fire control platform

wherein the means for generating a signal representing the predicted position of the object is located on the fire control platform, and the fire control platform is remote from the device.

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~~24~~. A method for guiding a device toward an object comprising the steps of:

obtaining object position parameters;

periodically adaptively producing an estimated object state;

creating a predicted position from the estimated object state; and,

determining a guidance command from the predicted position of the object.

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~~25~~. A method for guiding a device toward an object according to claim 24 comprising the steps of:

transmitting the predicted position of the object from a remote location to the device;

wherein the step of determining a guidance command is performed on the device.

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~~26~~. A method for guiding a device toward an object according to claim 24, comprising the steps of;

obtaining device position parameters;

determining at a remote location a time-to-intercept; and,

transmitting the time-to-intercept from the remote location to the device.

Add A6

Abstract

A system and method that guides a device to an object using periodically adaptive guidance. The guidance and control system creates a reconstructed line-of-sight (LOS) vector to avoid system destabilization associated with small angle approximations during high bore sight engagements. The guidance system adaptively estimates the periodic maneuver of evasive objects with a set of harmonically balanced Kalman filter banks. The Harmonically Balanced Kalman filter banks generate a set of probabilities that weight the effect of each individual Kalman filters on a resultant guidance command signal. The guidance command signal generated by the system acts perpendicular to the object LOS. The guidance and control system uses vectored proportional navigation guidance laws, optimal proportion navigation laws and periodically adaptive augmented guidance laws to generate a guidance command signal to supply to an autopilot.